SUBJECT TEACHING GUIDE

G1779 - Physics of Materials

Double Degree in Physics and Mathematics
Degree in Physics

Academic year 2022-2023

1. IDENTIFYING DATA				
Degree	Double Degree in Physics and Mathematics Degree in Physics		Type and Year	Optional. Year 5 Optional. Year 4
Faculty	Faculty of Sciences			
Discipline	Subject Area: Physics of Materials Mention in Fundamental Physics			
Course unit title and code	G1779 - Physics of Materials			
Number of ECTS credits allocated	6	Term	Semester based (2)	
Web	https://aulavirtual.unican.es			
Language of instruction	English		Mode of delivery	Face-to-face

Department	DPTO. CIENCIAS DE LA TIERRA Y FISICA DE LA MATERIA CONDENSADA
Name of lecturer	FERNANDO RODRIGUEZ GONZALEZ
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Office	Facultad de Ciencias. Planta: + 2. DESPACHO PROFESORES (2008)
Other lecturers	FERNANDO AGUADO MENENDEZ JAVIER RUIZ FUERTES

3.1 LEARNING OUTCOMES
- Knowledge and use of basic models and theories for describing the physical properties of materials.
- Skill development to setup experiments for measuring physical properties of materials.
- To employ of basic instrumental devices of interest in materials science.
- To be able of classifying and characterizing materials according to their structure.

4. OBJECTIVES
Classification and characterization of materials according to their structure and physical properties.
Knowledge of physical models enabling students to understand a wide variety of materials properties.
Measuring physical properties in different types of materials.
To acquire an ample background of knowledge and skillness in different experimental techniques and apparatuses of common use in research laboratory and industry.
The study of technical reports about a complex instrument to apply to new physical measurements.

6. COURSE ORGANIZATION	
CONTENTS	
1	Topic 1 Introduction. Types and classification of materials. Relationship between structure and physical properties.
2	Topic 2 Dielectric and Optical Properties of materials. Insulators and Semiconductors. Complex refractive index. Absorption and Reflection of light by Materials. Absorption and luminescence processes in solids. Configurational coordinate energy diagrams. Relevant Optical and Diectectric phenomena.
3	Topic 3 Electrical properties of materials. Insulator, Metals and Semiconductors. Band structure and conductivity.
4	Topic 4 Magnetic properties of materials. Magnetic phenomena: microscopic description. Diamagnetism, Paramagnetism and Ferromagnetism. Other magnetic structures: structural characterization.
5	Topic 5 Superconductivity. Experimental phenomena and characterization of superconductors. BCS theory. Predictions and new superconductor materials. Laboratory work: magnetic levitation
6	Topic 6 Functional and nanostructured materials. Structure and physical properties. Applications. Multifunctional materials. Interplay between properties and types of materials. Nanometric sized materials. Size effects and quantum confinement. Influence on physical properties.
7	Topic 7 Laboratory works: Microscopic techniques for materials analysis and characterization Optical absorption spectroscopy: electronic structure of insulators and semiconductors. Emission/excitation spectroscopy: Photoluminescent materials.
8	Topic 8 Laboratory works: Macroscopic techniques for analysis and characterization of materials Electrical resistivity in metals. Thermal effects. Characterization of Ferromagnetic and/or ferroelectric materials.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Practical work reports	Work	No	No	50,00
Final exam Test-type exam of all topics covered by the three controls. Control marks of passed controls can be used as marks for corresponding parts in the final exam. Each control exam will last 45 minutes.	Written exam	Yes	Yes	50,00
Each control exam will take place after finishing the corresponding topics. There will three controls for topics 1-2; 3-4; and 5-6. The marks can be used in the final exam.	Written exam	Yes	Yes	0,00
TOTAL				100,00

Observations

The student must do four experiments along the course in one 4-5 hour laboratory sessions in six different weeks. The experiments will be done by the students in the Solid State (S131), Diffractometry (1019), and Labo2 (1062) laboratories. The student must write three laboratory reports and one result sheet (Topic 5). The evaluation of each laboratory work will consist of 1) the experimental report and/or result sheet (80%) and 2) laboratory work (20%). The latter evaluation is based on a personal and continuous tracking about queries and attitude of the student in the laboratory (1,25 hr/report).
There will be three controls through test exams (45 min. each) and the final exam will last two hours.
The final grade of the course will be the average of grades obtained from laboratory works and exams.

In the event of an online teaching imposed by COVID19 or other causes, the laboratory work will be explained online and the corresponding experimental data will be transferred to each student for study and analysis following indications in the practical work guide. The evaluation will be done in the same way as in the lab, although the analysis work will be increased to compensate the lack of experimental work in the laboratory.

Observations for part-time students

The Professor will pay attention to provide additional teaching support to partial-time students.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

Topics 1-8
R. J. Naumann, Introduction to the Physics and Chemistry of Materials, CRC Press, Boca raton (2009).

Topics 1,2,6,7
M. Fox, Optical Properties of Solids, Oxford University Press, Oxford (2001).

Topics 1,3-6,8
K. H. J. Buschow and F. R. De Boer, Physics of Magnetism and Magnetic Materials, Kluwer (2003).